Greening Australia (NSW) Inc

MANAGEMENT PRINCIPLES TO GUIDE THE RESTORATION AND REHABILITATION OF INDIGENOUS VEGETATION

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Prepared by the Technical Sub-committee,
Greening Australia (NSW) Board.

Greening Australia
New South Wales
Greening Australia™

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1. INTRODUCTION

The purpose of this document is to guide those involved with carrying out indigenous revegetation works in a context of ecosystem restoration, rather than to guide all revegetation works undertaken by GANSW. This document exists in the broader context of policy document "Greening Australia Revegetation Policy" and should be read in conjunction with it.

The over-arching principle of Greening Australia's policy in relation to indigenous revegetation is that indigenous vegetation is to be retained, regenerated or reconstructed (as desirable and practicable) within the urban and rural landscape. This is to provide structural models and genetic stock for the long-term perpetuation of Australia's biodiversity, including the provision of fundamental and ongoing habitat for indigenous fauna.

To achieve this retention, regeneration and reconstruction, as appropriate, Greening Australia is involved in the following.

- Advocating better legislation to protect and better manage indigenous vegetation for both production and conservation.
- Providing advice to local catchment, regional and state vegetation committees.
- Delivering sound technical extension to land managers (via field days, publications and workshops etc.) regarding the values and management of indigenous vegetation and implementation of on-ground restoration and management works.

1.1 Historical context and future directions

The practice of restoring ecological communities is a relatively new field of endeavour. It emerged almost simultaneously in Australia and overseas in the first half of the twentieth century in response to the increasing decline of locally indigenous plant and animal communities. Since that time, ecological restoration practice has grown into an internationally significant movement, increasing rapidly in extent and seriousness.

One of the earliest recorded Australian ecological restoration projects was the fencing of the overgrazed and wind-eroded town common surrounding Broken Hill, NSW in the mid 1930s, initiated by the amateur botanist Albert Morris. Since that date, restoration projects have sprung up around the country, with significant developments occurring in the repair of rural land degradation and the assisted regeneration of urban conservation reserves.

One characteristic of the Australian restoration movement to date is that practitioners have not always had opportunities for interaction, resulting in less than optimum sharing of experiences, whether they be of successes or failures. Greening Australia is a national organisation committed to revegetation. As such, we are well placed to develop guidelines for restoration which can be useful not only to GANSW, but also to the restoration community at large. This document, then, reflects the aspirations of GANSW to both to ensure the maintenance and adoption of current best practice vegetation management in its own works – and to assist with the development of new and improved practices to restore and manage the State's vegetation resources.

1.2 Definition of restoration and rehabilitation

A spectrum of approaches exists to the repair of indigenous vegetation communities. At one end of the spectrum, the less complete but often appropriate *ecological rehabilitation* can offer opportunities to combine nature conservation with utilization – providing important habitat links. At the other end of the spectrum, the more complete, *ecological restoration* is appropriate for areas primarily dedicated to nature conservation.

Resource constraints and the specific goals of each project will determine the level of restoration/rehabilitation aspired to in each project. While “restoration” is preferred wherever it is possible and practicable, “rehabilitation” can be a desirable goal where limited finances and a need to utilise natural resources prohibit full restoration. Such rehabilitation, however, should be undertaken in a manner which progresses a vegetation community at least some way along a pathway towards restoration.

Similarly, the restoration approaches “protection”, “assisted regeneration” and “reconstruction” represent a spectrum of degrees of intervention often needed to achieve recovery of a vegetation community within a particular area. While the latter two approaches can blur in sites of intermediate degradation, *regeneration* approaches are most appropriate where natural recovery potential is high and *reconstruction* most appropriate where natural recovery levels are low.

1.3 Level of skills required

‘Best-practice’ indigenous restoration and rehabilitation requires specialist knowledge based on substantial exposure to both the theory and practice of ecological restoration. Untrained people from all walks of life can participate in ecological restoration, given appropriate technical guidance and can often make important discoveries regarding approaches and techniques. Greening Australia (NSW), however, must ensure that high levels of technical guidance and supervision are available to regeneration treatments in or near remnants, to avoid inadvertent damage to existing biodiversity.

1.4 Management principles

GANSW is aware that appropriate management and restoration treatments cannot always be identified in advance because of the (a) upredictable nature of many ecosystem responses and (b) the need for ongoing innovation in restoration technologies. GANSW therefore supports an “adaptive management” approach which includes:

- setting appropriate goals;
- developing and implementing interim strategies and treatments to address them;
- monitoring the impacts of these strategies and treatments; and
- modifying decisions and practices in the light of new information.

GANSW supports the incorporation of adaptive management approaches into programs wherever appropriate, particularly in cases where new revegetation challenges are being addressed.

1.5 Monitoring progress

GANSW strives to undertake at least some level of monitoring and evaluation of all projects, with more detailed monitoring usually confined to demonstration projects and new treatments.

A decision to undertake monitoring should be made at the commencement of a project, not at the end. This is necessary to ensure that the monitoring program is carried out in a manner that can provide reliable data for analysis and to ensure that it is based on good documentation of:

- prior condition;
- treatments used (including dates and locations); and,
- the reliable listing of any revegetation stock used (including genetic sources).

All projects should be monitored by at least periodic field visits and simple note-taking, comparing the post-treatment condition with (a) the site’s pre-treatment condition and (b) that of the “goal” vegetation community. More detailed monitoring may take the form of qualitative site descriptions and “before and after” photography **-** or may involve quantitative sampling. Where quantitative sampling is involved, advice should be sought in advance to ensure the sampling design is appropriate.

2. GENERAL REVEGETATION PRINCIPLES

2.1 Spatial planning principles

1. Where clearing or partial clearing of indigenous plant communities is needed in a primary production context, this should be undertaken in a manner that ensures that the largest unmodified area is conserved. The fragmentation of remnants is to be avoided. Partial clearing is preferred to complete clearing of all strata. Land use should be configured in such a way that the more intense types of land uses (which result in higher modification) are located at greater distances from remnant patches and buffered with less intense land uses (which result in less modification). These land uses should be configured to maintain habitat connectivity. This recommendation is based on the following ecological observations.

- Habitat fragmentation reduces the viability of populations of flora and fauna.
- The effect of grazing, exotic species, cultivation and other land management regimes on indigenous plant communities is lessened by both distance from the impact source and the lower intensity of the impact.
- Lower intensity zones can be useful in the production context as drought reserves and resource harvesting.
- Modified indigenous vegetation can increase risk of incursion into remnants by feral plants and animals.
- Increased edge/area ratios in remnants can increase decline of plant and animal communities, due to easier ingress of feral plants and animals.

2. Where possible, restoration and rehabilitation works should seek to stabilize and reverse the negative effects of habitat fragmentation. That is, priority should be given to works which protect and expand larger remnants so that they are reintegrated into larger revegetated areas. This is based on the following ecological observations.

- Habitat fragmentation generally reduces the viability of both faunal and floral populations by restricting ranges of fauna below minimum levels and by preventing the natural exchange of genetic material which may ensure genetic vigour.
- Reconnecting fragmented landscapes into larger, (and, where appropriate, more consolidated) units by filling in gaps can increase habitat area and may improve linkages for passage of species. (The configuration of those linkages, however, will determine whether edge/area ratios reduce or increase.)
- Narrow corridor links may themselves be subject to feral predation, disease and species imbalances, therefore, the width of a corridor should exceed the extent of edge effects.
- Biological potential for diverse natural regeneration and expansion frequently exists in and adjacent to remnants. Investments which harness this potential usually provide higher ecological returns than reconstruction elsewhere.

2.2 Clearly identifying revegetation goals

1. Greening Australia (NSW) recognizes that restoration/rehabilitation works must clearly identify which particular vegetation type, vegetation association or vegetation community is the goal of the revegetation works. This is based on the following ecological observations.

- Australian landscape mosaics are made up of aggregations of species which have evolved under different conditions. As such, they can respond differently to stresses and interventions - sometimes requiring specifically-tailored restoration treatments. At least six of these species groups can be identified. These include wetland, rainforest, grassland, saltbush and sclerophyll groups (including sclerophyll shrubs and/ or trees).

- Combinations of species form “communities” and “associations” characteristic of specific sites - making up the unique contribution of each site to biodiversity as a whole.
- Within those associations, the vegetation of specific project sites and their sub-sites are composed of particular combinations of plant species and genetic stock, even though exhibiting some dynamism over time. Revegetation goals should therefore be undertaken for specific sub-sites, and should reflect both pre-existing composition and pre-existing dynamics.

2. Unless conditions have changed irreversibly, the “endpoint” vegetation goal of a restoration or rehabilitation project should be modelled on the composition and dynamics of the pre-existing indigenous vegetation community. This is based on the following ecological and field observations.

- Projects which do not identify clear goals run the risk of becoming short-lived plantations rather than self-perpetuating vegetation communities.
- The likelihood of success is higher if specific goals identify the final composition and spacing of species (and other habitat elements) to be restored or rehabilitated within particular time frames.
- Even where no healthy pre-existing plant associations exists in the area, conceptual “reference communities” can be extrapolated from the closest examples for the particular soil type, aspect and hydrology. This can be assisted by historical records.

2.3 Clearly identifying revegetation approaches

(a) Fragmented landscapes

1. In or immediately adjacent to remnants, priority is given to facilitation of natural regeneration. In these locations, planting or direct seeding is only carried out where pre-existing species are incapable of colonization – and after a “rest” period sufficient to test natural regeneration. This is based on the following ecological and field observations.

- Natural regeneration potential can be surprisingly persistent in and adjacent to fragmented remnants.
- Natural regeneration maintains natural selection processes, can provide a wider range of site-adapted species and genetic stock, demonstrates any capacity for future regeneration, and informs us about a site’s regeneration dynamics and any pre-existing species requiring reintroduction.
- Planting can be more expensive, interfere with regeneration and compromise the genetic integrity and scientific value of a site. Planted stock may not regenerate if the species selection or genetic stock is inappropriate to the site.
- The mechanisms of recovery of individual species after natural disturbances (particularly whether they form persistent soil seed banks or not) can provide insight into the restoration approach needed. This determination can be improved by conducting preliminary trials to trigger germination from soil seed banks (e.g. using fire, smoke, tillage or irrigation as appropriate) - Such trials can also help to determine pre-existing plant associations more precisely.

2. The distance from a remnant where planting becomes necessary will depend on the individual species and vegetation grouping. For grassland and sclerophyll species, for instance, plantings may need to be closer to existing vegetation than in wetland and rainforest types, depending on how well propagule dispersal can progress. This is based on the following ecological and field observations.

- Few grassland and sclerophyll species are capable of dispersal over long-distances. Sufficient numbers of those species that cannot disperse will, therefore, need to be reintroduced within relatively short distances from a sclerophyll remnant edge. This need for reintroduction increases with the urgency of revegetation for soil stability, habitat or weed control.
- Seed of wetland plants, on the other hand, can be periodically dispersed along natural drainage channels and by floodwaters. Similarly, seed of bird- and bat-dispersed rainforest plants can be readily dispersed to “perch tree” plantings even at long distances from remnants. Where these perch tree species are short-lived, accelerated vegetation succession can result. Where seed source plantings are needed, these are best planted at a distance from the remnant edge to retain niches for natural recruitment within and at the expanding edges of the remnant.

3. The order of any reintroductions may also need to take into account potential effects of competition between species, to ensure that less competitive species are able to establish on site.

(b) "Variegated" landscapes

Combinations of assisted regeneration and reconstruction approaches are likely to be required in landscapes where "diffuse" modification has occurred, leaving no intact remnants. Yet the difficulty and complexity of this will depend upon the degree of impact and the number of species involved. This is based on the following ecological and field observations.

- Whole groups of species (such as forbs, perennial grasses and sub-shrubs) may be removed across a grazed or over-burnt landscape; reducing the vegetation to a limited number of trees, shrubs or short-lived grasses.
- While some trees and some shrubs may be relatively easy to re-establish, successful rehabilitation of the ground stratum is likely to require a complex combination of direct seeding and applied disturbances to control undesirable species and foster the recovery of desirable species.

2.4 Fauna and enhancing habitat values

The goals of GANSW's restoration and rehabilitation projects include protecting faunal populations and restoring faunal habitats. This necessitates, prior to revegetation, the assessment of existing and pre-existing faunal populations and current habitat uses. This is based on the following ecological observations.

- Native fauna are dependent on vegetation for their survival.
- Restoration treatments can inadvertently destroy critical habitat.
- Vegetation survival processes (such as pollination and dispersal) are often dependent upon faunal interactions.
- Where habitat is required for the less well-represented (often "interior"-dwelling) faunal species, reconstructed habitat should be as wide as possible. Otherwise these species may be out-competed by (the more "edge"-dwelling) species already well-represented in the farm landscape.
- Improvements in faunal habitat can be achieved by: managing feral animals; retaining (or where necessary) re-introducing fallen logs and rocks; retaining standing dead trees and branches; maximizing the *area* (as opposed to *edge*) of the revegetation zone; and, prioritizing (e.g. in woodlands) the reinstatement of understorey for small bird habitat.

2.5 Weed control

1. No environmental weed species are to be used in restoration /rehabilitation works, including Australian species which are not local to the particular area. This is based on the following ecological observations.

- Many introduced species have become "naturalized" (i.e. they naturally regenerate) in their new location and can function as environmental weeds. A great many of these are highly invasive and can out-compete locally-indigenous vegetation.
- While not all introduced species naturalize in their new location, it is difficult to predict which newly-introduced exotic species will become environmental weeds, as this process can sometimes take many decades.
- Some NON-naturalizing introduced 'cover crops' can be useful in restoration and rehabilitation projects – by protecting newly germinating indigenous species from over-exposure, helping intercept wind dispersal of native seed; and, providing a temporary habitat "bridge" for fauna until more permanent habitat establishes.

2. Weed control works can be critical to the survival of remants but success can only be assured where sufficient on-site technical knowledge / supervision is available, and a commitment is made by the site's managers to follow-up weeding and site maintenance. These points are based on the following site observations.

- Weed species usually increase in density after the removal of their parent plant, due to the germination of weed seeds already on site. If such regenerating weeds are allowed to mature and produce fresh seed, even higher weed levels can result after treatment than previously occurred.
- Different weed species often require special control treatments to ensure they are effectively treated.
- Native species can be easily damaged by inexact weed control treatments, delaying the process of successfully replacing weeds with natives.

2.6 Incorporating production and land and water rehabilitation principles

Every opportunity is taken by Greening Australia (NSW) to integrate the concept of restoration/rehabilitation for biodiversity with revegetation for production improvements and land and water conservation. This more holistic approach is based on the following field observations.

- Erosion repair can often be achieved by revegetation (as appropriate to site conditions).
- Faunal corridor vegetation can contribute shade and shelter to farm animals.
- Nutrient sumps (using indigenous wetland vegetation) can help protect streams from pollution.
- Revegetation can reduce water table elevation and thus reduce salinity exposure.
- Some indigenous species can provide land rehabilitation and/or production resources (such as for farm forestry, fibre production or grazing).

3. RESOURCE AND SITE ANALYSIS PRIOR TO IMPLEMENTATION

3.1 Identifying the appropriate "degree" of intervention needed

1. "Best fit" revegetation approaches are likely to be those which most precisely compensate for the degree of damage, rather than being either excessive or insufficient. This is based on the following ecological and field observations.

- Recovery may not occur in some "higher-damage" cases if the level of intervention is insufficient to overcome barriers or to compensate for damaged or missing components.
- Recovery may not occur in other "lower damage" cases if the level of intervention is so high that it overwhelms valuable natural regeneration capacity.
- Minimal intervention is most conserving of scarce resources.

2. Combinations of approaches may be needed on a site. This is based on the following observations.

- *Sub-zones* within a site can be more highly degraded (requiring a reconstruction approach), where others may be less degraded (requiring a regeneration approach).
- Individual species can be more rapidly affected than others by particular degradation impacts, so some *species* may need a reconstruction approach while others need only a regeneration approach.

3. Restoration interventions must be customised to the regeneration biology and dynamics of individual species. This is based on the following observations.

- Recovery cannot occur where conditions are contrary to the biological requirements of the individual plants.
- Different plant groups can have widely differing regeneration biologies. That is, for recovery after disturbance, species may variously depend on resprouting, stored seed or the the production of fresh seed.
- These differences commonly occur within the same genus – and can even occur within the same species in the case of a locally-adapted "ecotype".

4. Successful restoration requires planning to ensure adequate resources are available for weed control – particularly at longer-degraded sites. This is based on the following observations.

- Higher levels of weed occur on sites exposed to weed invasion for longer periods or sites closer to weed propagule sources.

- Even on sites of lower weed levels, weed flushes are frequently triggered by restoration treatments themselves (such as *initial* weed control, grazing exclusion, prescribed burning and/or planting) producing a demand for *follow-up* weed control activities.
- While the demand for weed control may gradually drop over time (assuming prevention of new weed seed production and the absence of disturbance) a high demand for follow-up weed control usually occurs during the initial years immediately after treatment.
- While most weed species can be reduced to manageable levels, given adequate initial control, the prevention of new seed production and the absence of distubances, longer term *maintenance* is still necessary to prevent re-invasion by residual or freshly-dispersed weed propagules. A requirement for weed control may also be expected after each subsequent natural or human-induced disturbance on a restored site.

5. The need for follow-up weed control treatments, and the resources available to meet this need, will dictate the restoration area (m^2) **that can be safely undertaken in any one budget year**. This is based on the following field observations.

- Overestimating the area that can be reliably followed-up has often resulted in failure to adequately control weeds, sometimes resulting in higher-than-previous weed levels.
- Correctly estimating, or even under-estimating, the area that can be followed-up ensures a capacity to complete treatments to a satisfactory standard.

4. IMPLEMENTATION

4.1 RETAINING

4.1.1 Principles and priorities

Greening Australia (NSW) promotes community awareness of the principles and methods of protecting the integrity and regenerative capacity of natural vegetation. This commitment holds for both indigenous vegetation managed for production purposes and indigenous vegetation dedicated solely to biodiversity conservation. This is based on the following ecological and field observations.

- Indigenous species can be resilient to some forms and degrees of disturbances that are similar to disturbances that occur in the natural environment in which the species have evolved. This means that forms and degrees of human utilization which are similar to natural disturbance regimes can be compatible with the persistence of healthy indigenous ecosystems – yet those which are dissimilar to natural regimes can be incompatible.
- We can predict something of the capacity of a site to tolerate or recover from human activities by examining the degree to which these activities resemble natural disturbance regimes to which the vegetation is adapted. This helps us to plan or redesign developments so they fall within the capacity of remnant vegetation to persist.
- Prevention is more cost-effective (and ecologically effective) than cure.

4.1.2 Methods of "retention"

Retention involves the protection of remnant vegetation from damage and the implementation of management regimes to optimise the persistence of remnants.

Practices which can reduce negative impacts upon remnants include:

- Fencing remnants from stock, while allowing native fauna movement
- Carefully matching irrigation to the needs of production, reducing unnecessary elevation of saline water tables.
- Protecting soils and water from pollution, including nutrient runoff.
- Ensuring equipment and imported materials do not introduce weed seeds.

- Controlling invasive plants and animals before they reach destructive or unmaneageable proportions.
- Avoidance of mechanical, fire and grazing regimes which damage the self perpetuation capacity of native plant species or the habitat of animal species.
- Maintenance of particular fire and grazing regimes essential to retaining the self-perpetuation capacity of native vegetation and the habitat of animal species.

4.2 REGENERATING

4.2.1 Principles and priorities

1. **<u>Apply the minimum intervention necessary for success</u>. For both economic and ecological reasons, it is wise to invest the minimum level of intervention required to achieve an appropriate restoration outcome. As this minimal intervention will be determined by the degree of damage to the site, intervention may only need to be a *regeneration* approach - or may need to be a *reconstruction* approach.** This is based on the following observations.

- The capacity of a site to regenerate generally declines with increasing damage. *Assisted* r*egeneration* (lower intervention) approaches are generally more appropriate, for instance, in sites of lower damage – and include passive interventions (e.g. removal of the initial cause of degradation) or active interventions (e.g. those required to "kick start" recovery that has been stalled by the absence of key resources or dynamic processes). *Reconstruction* (higher intervention) approaches, on the other hand, become progressively more important in more damaged sites (or parts of sites). These approaches involve major amendment to substrates and the reinstatement of a majority of organisms.
- As the same degrading impacts can affect some species more than others, reconstruction approaches for some species may be combined with regeneration approaches for others.

<u>2. Carefully assess potential for regeneration prior to determining whether a regeneration or reconstruction approach is necessary.</u> Where regeneration is possible, benefit can be gained from giving precedence to assisted regeneration methods over unnecessary reconstruction. Where species are clearly missing and cannot regenerate, however, reconstruction should proceed without undue delay. This is based on the following ecological and field observations.

- Strategically managing, rehabilitating and expanding existing indigenous vegetation can be a more efficient, cost-effective and ecologically-effective way of achieving our goals than focusing on artificially revegetating more highly degraded areas – particularly where inappropriate plantings can compromise the functional and genetic integrity (and research potential) of remnants. On the other hand, if restoration of highly degraded sites is important for some particular habitat reason, or where their remediation may prevent degradation of other important sites, their early treatment may be justified.
- In their healthy state, most if not all indigenous species are capable of regenerating after natural disturbances to which they are adapted. As this capacity is inbuilt within the physical attributes of such species (i.e. resprouting or seed storage), it can also come into play after human-induced impacts – but only to the extent that these impacts resemble the conditions to which the species are adapted.
- In some cases natural
nearby canopies, available for regeneration after the reintroduction of dynamic processes (such as fire in sclerophyll or rangeland communities, flooding and drying in wetland, or dispersal perches in rainforests to which fresh seed can be dispersed by birds and bats).

- Where this regeneration capacity is destroyed; however - or where other important ecosystem processes need artificial remediation (e.g. in cases of reduced gene pool) - planting or direct seeding is an essential pre-requisite to recovery.

- Leaving a heavily weed infested (or weed-prone) site to revegetate by natural regeneration alone can be a serious mistake if there is nil, or very low, natural regeneration capacity. This is particularly the case where the site is prone to erosion or other forms of degradation.

4.2.2 Methods of "regeneration"

(a) Amend degradation processes and causes such as the following.

- **E**xcessive livestock and feral animal grazing (at least during recovery period of sensitive species).
- **V**ehicular or people traffic.
- Inappropriate fire regimes.
- Inappropriate hydrological regimes.
- Inappropriate nutrient regimes.
- Soil and water pollution.
- Habitat fragmentation.
- Removal of timber or dead wood.

(b) Apply "triggers" for recovery appropriate to species or at least vegetation type, such as:

- Maximise regeneration niches that would normally occur (e.g. by contour furrowing, debris laying, cover cropping or waterponding as appropriate to species or vegetation type) .
- Apply triggers (such as hot patch burns, smoke or tillage if buried sclerophyll seed banks; bird perch trees if rainforest; or flood irrigation for many species occurring in drier climates).
- Disturb roots if appropriate (to induce suckering in non-seeding resprouters if involving resprouting relict trees).
- Control naturalised exotics (to release resources available for regeneration of natives in any vegetation type).

(c) Reintroduce seed sources where known to be missing.

(d) F**ollow up** by making repeated visits to monitor recovery and to undertake further treatments as necessary. (This is most important as subsequent generations of weed species are invariably triggered to germinate by the disturbance caused by any restoration treatment).

4.3 RECONSTRUCTING

4.3.1 Principles and priorities

1**. Greening Australia (NSW) recognises that planting or direct seeding is necessary for re-establishing indigenous vegetation on sites where regeneration potential has been severely depleted. In some cases, the reconstruction goal may be to restore the entire pre-existing vegetation community to the extent practicable. In others (for practical or production reasons) the goal may be to rehabilitate only enough of the pre-existing species to initially reinstate basic functions and habitat values. However, such treatments should not prejudice the possibility of more advanced restoration in the future.** This is based on the following ecological findings and field observations.

- Reconstruction may be desirable in broad empty spaces between remnants to counter the effects of habitat fragmentation.

- Reconstruction may be needed to achieve broad-acre revegetation where natural regeneration cannot occur.

- Full or partial reconstruction may be valuable in remediating land degradation including problems of erosion or salinity.

2. In cases where site conditions have been so altered that the pre-existing vegetation community cannot perpetuate on site in the long term, construction of an alternative locally occurring indigenous vegetation community is a potential option. *A*n example is the construction of a salt-tolerant indigenous vegetation on salt-affected sites that previously carried upland vegetation. While this is strictly not restoration [??]it is an approach available to restoration managers concerned with reinstating integrity in vegetation communities.

4.3.2 Methods of "reconstruction"

(a) Species selection for reconstruction

Species selection for projects depends on whether the goal is full or partial ecosystem reconstruction. If the former is the goal, the pre-existing species should all be reinstated where practicable. Where the latter is the goal, only those species that are desirable and/ or compatible with the amenity use or commercial production need be reinstated. The following points need to be taken into account where biodiversity goals are uppermost.

- Reinstating the site's pre-existing vegetation (and genetically effective populations of species) is important to the goal of conserving biodiversity.

- The site's pre-existing species (and genetic stock) have already proven themselves capable of naturally perpetuating on the site – and are likely to still be capable of this as long as the site conditions remain consistent with those previously existing.

- Benefits can be sometimes be gained by reintroducing some species before others to avoid exclusion by more competitive species.

- The pre-existing mix of growth forms (e.g. shrubs and trees and ground covers) is likely to be important in achieving a functioning ecosystem - and so should be represented to the degree practicable.

- Non- site indigenous species that perpetuate outside their range may become weeds in bushland remnants or at remnant edges and must be avoided.

b) Ensuring genetic integrity and genetic diversity

Where indigenous species are being used, propagation material must be sourced within the species' predicted local provenance area. Within this area, collection from closer sources is generally preferred to supplementation from sources further afield, as long as collection is not so

[??]Elsewhere this approach is variously termed "creation", "fabrication" or "type conversion"

close to the receiving site that only closely related individuals are planted in the same area. All propagation material must be collected from a range of well-spaced parents to ensure potential for reproduction and to avoid inbreeding. Where this standard cannot be achieved for sites within given time frames, serious consideration should be given to delaying or extending the project so that the standards can be achieved. These points are based on the following ecological principles.

- The conservation of site-adapted genotypes is a primary goal of the conservation of biodiversity.
- Site-adapted genotypes may be more capable of reproducing and establishing on particular site conditions than those further afield.
- Propagation material found closer to the site (or to the parent plant) is likely to be more closely related genetically than those further afield.
- Many species will not reproduce with close relatives and reproduction from collected stock may be dependent on collection from a dispersed range of parents
- The implications of supplementation with genetic material very distant from the site, even within what might be considered a provenance area, are not well known for all species – particularly those with naturally low gene flow due to short-range dispersal and pollination characteristics.

c) **<u>Site preparation and maintenance</u>**

Greening Australia (NSW) strives to ensure the following phases of revegetation works are satisfactorily carried out wherever they are necessary and practicable:

- **A**ppropriate soil surface preparation (e.g. scalping, ripping or furrowing etc.)
- **W**eed control.
- Erosion control.
- Fencing to control grazing or feral predators.
- Planting, transplanting or direct seeding with high quality stock
- Initial watering where necessary.
- Follow-up weeding where necessary.
- Mycorrhizal inoculation, where necessary.
- Periodic inspections to check the progress of the restoration/ rehabilitation.

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GLOSSARY OF TERMS USED IN THIS DOCUMENT

Disturbance — Physical perturbation of soil or vegetation. Natural examples include fire, Storm damage, repeated flooding, freezing herbivory and animal diggings. Human-induced examples include soil disruption by machinery, vegetation Clearing, use of fire or managed grazing etc.

Dynamics — processes of change within ecosystems, often reflecting regimes of disturbance and lack of disturbance.

Exotic — *c*oming from another area, not occurring naturally in that area without recent human agency

Function — *1*. energy flows and nutrient cycles within an ecosystem.
2. all processes (whether function or dynamics) of an ecosystem

Habitat — *t*he particular environment of a living organism upon which that organism depends. plant, for instance, may provide animal habitat or habitat for other plants.

Indigenous — *w*ith a long history of occurrance in a defined area

Locally - *indigenous* — with a long history of occurrance in a defined local area

Migratory — moving from one site to another.

Natural regeneration - spontaneous germination or resprouting.

Resilience — the degree, manner and pace of the recovery of initial structure and function of an ecological community after disturbance.

Resilience potential - unexpressed capacity for recovery after disturbance (such as by germination or resprouting)

Reconstruction - the artificial rebuilding of a damaged site's pre-existing indigenous ecological community from scratch.

Restoration	process of - or end result of - reinstatement of the structure and dynamics of a damaged site's pre-existing indigenous ecological community.
Weed bank	reserve of seed (stored in the ground or canopy).
Structure	*1*. three-dimensional architecture of an ecosystem *2 a*ll physical components of an ecosystem
Succession	order or sequence of vegetation development after disturbance.
vegetation	*i*ncludes trees, shrubs, grasses, forbs and other growth forms, separately and together
weed	a self-perpetuating plant species that can out-compete other species over time (usually exotic, although some locally indigenous species can behave like weeds if not balanced by other native species).
En*vironmental* *Weed*	a plant which has a negative impact on the health of ecosystems